

PATENT SPECIFICATION

DRAWINGS ATTACHED

Citation 3

847,569



Date of Application and filing Complete Specification:
December 16, 1958.

No. 40486/58.

Application made in United States of America on
December 19, 1957.

Complete Specification Published September 7, 1960.

Index at Acceptance: Class 80(2), USA2.

International Classification: F06d.

Improvements in universal joints.

COMPLETE SPECIFICATION

ERRATUM

SPECIFICATION NO. 847,569

Page 1, line 70, after "of" insert "registering grooves in position of axial"

THE PATENT OFFICE,
10th November, 1960

DS 82174/1(5)/8485 200 10/60 DL

20 remains always the same in whatever posi-
tion of angular adjustment between the axes
of rotation of the two members. This is
dependent upon maintaining the plane of
the balls so as to bisect the angle between
25 the axes of the members in all working
positions of the members. At the present
time, this is accomplished by a groove
development which develops all outer race
grooves from a single center at one side of
30 the intersection between the axes of rota-
tion of the members, and which develops
all inner race grooves from a center at the
opposite side of and spaced an equal dis-
tance from said intersection. This practice
35 of groove development though it maintains
the ball cage in its correct geometric posi-
tion causes an unbalanced force due to the
centrifugal force of the balls in the off-
center grooves which produces end thrust
40 or axial thrust on the spherical surfaces of
the ball cage and mating surfaces. At high
speed, these forces are considerable and
cause excessive heat, seizure and failure of
the joint.

45 It is the object of this invention to pro-

registering grooves in position of axial 65
alignment of said members diverging in one
axial direction and being concentric to
points in said axes equally spaced from and
on opposite sides of said fixed intersection,
and the surfaces in the remaining sets of 70
alignment of said members diverging in the
opposite axial direction and being concen-
tric to points in said axes equally spaced
from and on opposite sides of said fixed
intersection. 75

According to another aspect of this in-
vention a universal joint comprises inner
and outer members relatively angularly
movable about a fixed intersection in their
rotational axes and having arcuate meri-
dian ball race grooves and balls engaging 80
said grooves, means operating during rela-
tive angular movement of the rotational
axes of said members for positively moving
said balls so that the plane thereof always 85
bisects the angle between said axes, said
means comprising inner and outer surfaces
on said inner and outer members respec-
tively operatively associated with certain of
said balls, said inner and outer surfaces in 90

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We, DANA CORPORATION, a corporation organised and existing under the laws of the State of Virginia, United States of America, of Toledo, County of Lucas, State of Ohio, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to universal joints and refers more particularly to constant velocity universal joints of the type comprising spherically engaged inner and outer members coupled together by a series of balls engaging registering arcuate meridian race grooves in the members.

In a joint of this type, the relative speed of rotation of the drive and driven members remains always the same in whatever position of angular adjustment between the axes of rotation of the two members. This is dependent upon maintaining the plane of the balls so as to bisect the angle between the axes of the members in all working positions of the members. At the present time, this is accomplished by a groove development which develops all outer race grooves from a single center at one side of the intersection between the axes of rotation of the members, and which develops all inner race grooves from a center at the opposite side of and spaced an equal distance from said intersection. This practice of groove development though it maintains the ball cage in its correct geometric position causes an unbalanced force due to the centrifugal force of the balls in the off-center grooves which produces end thrust or axial thrust on the spherical surfaces of the ball cage and mating surfaces. At high speed, these forces are considerable and cause excessive heat, seizure and failure of the joint.

It is the object of this invention to pro-

vide a constant velocity universal joint in which the resultant end thrusts or forces balance each other, and in particular to accomplish this result by a novel ball groove development.

According to one aspect of this invention a universal joint comprises inner and outer members relatively angularly movable about a fixed intersection in their rotational axes and having arcuate meridian ball race grooves therein, balls engaging said grooves, means operating during relative angular movement of the rotational axes of said members for positively moving said balls so that the plane thereof always bisects the angle between said axes, said means comprising surfaces in registering grooves of said inner and outer members, the surfaces in certain sets or in each alternate set of registering grooves in position of axial alignment of said members diverging in one axial direction and being concentric to points in said axes equally spaced from and on opposite sides of said fixed intersection, and the surfaces in the remaining sets of alignment of said members diverging in the opposite axial direction and being concentric to points in said axes equally spaced from and on opposite sides of said fixed intersection.

According to another aspect of this invention a universal joint comprises inner and outer members relatively angularly movable about a fixed intersection in their rotational axes and having arcuate meridian ball race grooves and balls engaging said grooves, means operating during relative angular movement of the rotational axes of said members for positively moving said balls so that the plane thereof always bisects the angle between said axes, said means comprising inner and outer surfaces on said inner and outer members respectively operatively associated with certain of said balls, said inner and outer surfaces in

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position of axial alignment of said members diverging in one axial direction and being concentric to points in said axes equally spaced from and on opposite sides of said fixed intersection, additional inner and outer surfaces on said inner and outer members respectively operatively associated with certain other of said balls, said additional inner and outer surfaces in position of axial alignment of said members diverging in the opposite axial direction and being concentric to points in said axes equally spaced from and on opposite sides of said fixed intersection.

Other objects and features of the invention will become apparent as the description proceeds, especially when taken in conjunction with the accompanying drawing, illustrating a preferred embodiment of the invention, wherein:

Fig. 1 is a longitudinal sectional view through a universal joint embodying the invention, taken on the line 1—1 of Fig. 2.

Fig. 2 is an end view of the joint.

Fig. 3 is a longitudinal sectional view taken on the line 3—3 of Fig. 2.

Referring now more particularly to the drawing, the inner spherical member 10 has an external spherical surface 11 and is internally splined for connection to a shaft. The outer spherical member 14 has an internal spherical surface 15 and also is adapted to be connected to a shaft. A spherical cage member 18 is interposed between the members 10 and 14. Balls 20 engage within segmental circumferentially spaced slots 16 in the cage member, and also engage the registering arcuate meridian ball race grooves 22 and 24 in the inner and outer members.

The engaging spherical surfaces of the members 10, 14 and 18 are all concentric with respect to the point 26, which is the fixed intersection between the axes of rotation of the members 10 and 14 in any relative angular position of these axes.

Alternate grooves in the outer race member are concentric with the point 28 which lies on the coincident axes of rotation of the members 10 and 14 in the position of alignment of said axes, at one side of the fixed intersection 26. The remaining ball race grooves of the outer member are concentric with the point 30 which lies on the coincident axes of rotation of the members in the position of alignment of said axes, at the opposite side of and spaced an equal distance from the fixed intersection 26. The radius of the alternate grooves is indicated by R1 and of the remaining grooves by R2.

The grooves in the inner member which register with the alternate grooves of the outer member are concentric with the point 30, and the remaining grooves of the inner member are concentric with the point 28.

The radii of these grooves are indicated by the letters R4, and R3, respectively.

The registering grooves thus are not concentric but diverge from one another, half the sets of registering grooves diverging in one axial direction and the remaining sets diverging in the other axial direction. Thus the registering grooves at the top of Fig. 1 will produce an end thrust on the ball and cage to the left, whereas the registering grooves at the bottom of the figure produce an end thrust to the right. This is in contrast to prior constructions in which all sets of registering grooves diverge in the same direction and hence produce an end thrust in the same direction. In accordance with this improved construction, three sets of registering grooves produce an end thrust in one direction and the other three produce an end thrust in the opposite direction. Therefore, the end thrusts balance each other with the result that there is substantially no resultant end thrust in the joint.

The joint is therefore capable of increased speed of operation without the accompanying generation of heat and possible failure that exists with prior constructions.

WHAT WE CLAIM IS:

1. A universal joint comprising inner and outer members relatively angularly movable about a fixed intersection in their rotational axes and having arcuate meridian ball race grooves therein, balls engaging said grooves, means operating during relative angular movement of the rotational axes of said members for positively moving said balls so that the plane thereof always bisects the angle between said axes, said means comprising surfaces in registering grooves of said inner and outer members, the surfaces in certain sets or in each alternate set of registering grooves in position of axial alignment of said members diverging in one axial direction and being concentric to points in said axes equally spaced from and on opposite sides of said fixed intersection, and the surfaces in the remaining sets of registering grooves in position of axial alignment of said members diverging in the opposite axial direction and being concentric to points in said axes equally spaced from and on opposite sides of said fixed intersection.

2. A universal joint comprising inner and outer members relatively angularly movable about a fixed intersection in their rotational axes and having arcuate meridian ball race grooves and balls engaging said grooves, means operating during relative angular movement of the rotational axes of said members for positively moving said balls so that the plane thereof always bisects the angle between said axes, said means comprising inner and outer surfaces on said inner and outer members respec-

tively operatively associated with certain of said balls, said inner and outer surfaces in position of axial alignment of said members diverging in one axial direction and being
10 concentric to points in said axes equally spaced from and on opposite sides of said fixed intersection, additional inner and outer surfaces on said inner and outer members respectively operatively associated with cer-
15 tain other of said balls, said additional inner and outer surfaces in position of axial alignment of said members diverging in the opposite axial direction and being concentric to points in said axes equally spaced
20 from and on opposite sides of said fixed intersection.

3. A universal joint as claimed in claim 1 or 2 in which a cage is provided between said inner and outer members and said balls
25 are mounted in said cage.

4. A universal joint as claimed in claims 1, 2 or 3 in which the points at one side of said fixed intersection coincide and those at the other side thereof also coincide.

30 5. A universal joint as claimed in claim

1, 2 or 3 in which the points on one side of said fixed intersection are coincident and the points on the opposite side of said fixed intersection are coincident in the position of alignment of said members.

6. A universal joint as claimed in claim 1 in which the number of remaining sets of registering grooves is one half the total number of sets of registering grooves.

7. A universal joint constructed and arranged substantially as herein described with reference to and as illustrated in the accompanying drawings.

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Chartered Patent Agents.

FIG.1.

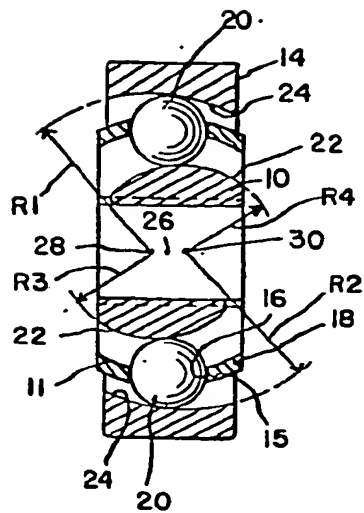


FIG.2.

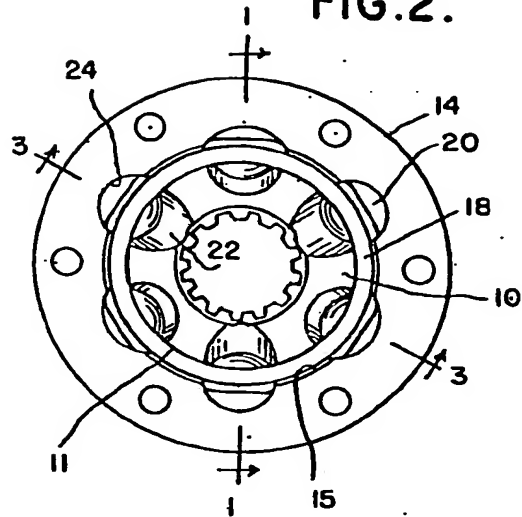
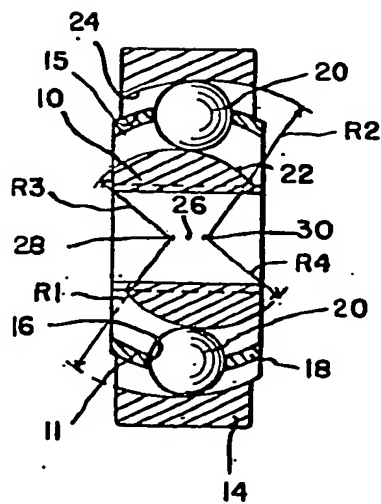


FIG.3.



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